Stoller
Hanford Office

HGLP-LDR-006

299-W18-81 (A7564)
Log Data Report

Borehole Information:

Borehole:	299-W18-81 (A7564)		Site:	216-Z-1A Crib	
Coordinates (WA St Plane)		GWL[1] (ft):	None	GWL Date:	07/17/06
North (m)	East (m)	Drill Date	TOC Elevation	Total Depth (ft)	Type
135434.168	566546.238	04/67	676.50	41	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel	2.3	6 5/8	6	5/16	2.3	41

Borehole Notes:

The logging engineer measured the casing stick-up and diameter using a caliper and steel tape. Logging data acquisition is referenced to the TOC. According to the driller's log, contamination was encountered from 14 ft to the bottom of the borehole.

Logging Equipment Information:

Logging System:	Gamma 1E		Type:	SGLS (70%) SN: 34TP40587A
Effective Calibration Date:	05/02/06	**Calibration Reference:**	DOE-EM/GJ1200-2006	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 4H		Type:	NMLS SN: H310700352
Effective Calibration Date:	03/06/06	**Calibration Reference:**	DOE-EM/GJ1154-2006	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 4I		Type:	PNLS SN: U1754
Effective Calibration Date:	Not required	**Calibration Reference:**	None	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3 Repeat	4 Repeat	
Date	07/17/06	07/18/06	07/18/06	07/19/06	
Logging Engineer	McClellan	McClellan	McClellan	McClellan	
Start Depth (ft)	40.0	30.0	40.0	27.0	
Finish Depth (ft)	29.0	2.0	26.0	12.0	
Count Time (sec)	200	200	400	400	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	

Log Run	1	2	3 Repeat	4 Repeat	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A[2]	N/A	N/A	N/A	
Pre-Verification	AE175CAB	AE177CAB	AE177CAB	AE178CAB	
Start File	AE176000	AE177000	AE177029	AE178000	
Finish File	AE176012	AE177028	AE177043	AE178015	
Post-Verification	AE176CAA	AE177CAA	AE177CAA	AE179CAA	
Depth Return Error (in.)	+ 1	+ 0.5	0	0	
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	5	6 Repeat			
Date	07/20/06	07/20/06			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	2.25	12.0			
Finish Depth (ft)	40.0	40.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
Sample Interval (ft)	0.25	0.25			
ft/min	1.0	1.0			
Pre-Verification	DH172CAB	DH172CAB			
Start File	DH172000	DH172152			
Finish File	DH172151	DH172264			
Post-Verification	DH172CAA	DH172CAA			
Depth Return Error (in.)	N/A	N/A			
Comments	None	None			

Passive Neutron Logging System (PNLS) Log Run Information:

Log Run	7	8 Repeat			
Date	07/20/06	07/20/06			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	3.0	12.0			
Finish Depth (ft)	40.0	40.0			
Count Time (sec)	60	60			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	DI442CAB	DI442CAB			
Start File	DI442000	DI442038			
Finish File	DI442037	DI442066			
Post-Verification	DI442CAA	DI442CAA			
Depth Error (in.)	N/A	N/A			
Comments	None	None			

Logging Operation Notes:

Logging was conducted with a centralizer on each sonde and measurements are referenced to top of casing. Repeat data with the SGLS were acquired at a 400 second counting time from 12 to 40 ft to provide additional detail of the highest activity zone. Because the repeat data acquired at 400 seconds are statistically more valid than data acquired at 200 seconds, the repeat data are plotted in the main logs.

Analysis Notes:

Analyst:	Henwood	Date:	09/28/06	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after each day's data acquisition. The acceptance criteria were met.

A casing correction for 5/16-in.-thick casing was applied throughout the borehole for the SGLS.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G1EMay06.xls using an efficiency function and corrections for casing and dead time as determined from annual calibrations. The NMLS count rate data were converted to volumetric moisture according to calibration data for a 6-in. borehole. The passive neutron logging system data are used for qualitative purposes and does not require a calibration.

Results and Interpretations:

^{137}Cs is detected at 2 and 3 ft at approximately 0.2 pCi/g.

^{237}Np is detected with the SGLS by measuring a daughter product (protactinium-233 (^{233}Pa)) that emits a prominent gamma ray at an energy of 312.17 keV. ^{233}Pa was detected from 13 to 40 ft. The maximum concentration is approximately 78 pCi/g at a 24 ft depth.

^{239}Pu was detected in this borehole at levels near its MDL that could not be adequately quantified. Gamma energy peaks normally used to quantify ^{239}Pu at 375.05 and 413.71 keV had interference from gamma rays at 376.65 keV (^{241}Am), 375.45 keV (^{233}Pa), 415.88 keV (^{241}Am), 415.76 keV (^{233}Pa). The 129.3 keV gamma ray originating from ^{239}Pu was observed. However, this energy is out of the calibration range for the SGLS (186 to 2615 keV). The concentration determined from the 129.3 keV ^{239}Pu gamma ray is estimated at approximately 14,000 pCi/g.

^{241}Am is detected from 21 to 40 ft and at 13 ft. The maximum concentration is measured at approximately 225,000 pCi/g at 33 ft. Gamma rays at 662, 722, and 208 keV were detected that represent ^{241}Am. ^{137}Cs emits a 661.66 gamma ray that cannot be distinguished from the 662.40 gamma ray emitted from ^{241}Am. A corroborating energy peak at 722.01 keV is used to establish the presence of ^{241}Am rather than ^{137}Cs. In this borehole the 722.01 keV energy peak is used to determine the ^{241}Am concentration. There appeared to be few or no residual counts in the 662 keV peak that could be attributed to ^{137}Cs.

Passive neutron logging was performed in the borehole. This logging method has been shown to be effective in qualitatively detecting zones of alpha-emitting contaminants from secondary neutron flux generated by the (α,n) reaction and may indicate the presence of α-emitting nuclides, including transuranic radionuclides, even where no gamma emissions are available for detection above the MDL. The passive neutron signal depends on the concentration of α sources, and also the concentrations of lighter elements such as N, O, F, Mg, Al, and Si which emit neutrons after alpha capture. The passive neutron log indicated a maximum count rate of approximately 4 counts per second (cps) at 13 ft. This count rate can be contrasted with that observed in other boreholes in the 216-Z-1A crib where the count rates can exceed 2000 cps. Part of the reason for the lower count rate is the lower concentrations of transuranics, thus less alpha activity, relative to other boreholes. It is likely Pu is at low concentrations, and/or does not exist as a fluoride compound. ^{19}F has a much higher capture cross section for alpha particles, compared to other light elements such as oxygen or nitrogen, and has been detected in other high count rate boreholes. While alpha emitting contaminants are indicated by the passive neutron log from 12 to 40 ft, the highest count rate is observed at 13 ft where the SGLS detected no appreciable amounts of transuranics above the respective MDLs. A possible explanation is that an accumulation of transuranic radionuclides exist at this depth at concentrations just below the MDLs.

The naturally occurring radionuclides (KUT) indicate an unusual profile for Hanford sediments. Below 12 ft the concentrations are uniform and the concentrations appear to be low relative to that indicated in other nearby boreholes. This could be an indication that borehole construction differs from that documented in the Well Construction and Completion Summary. For example, the log profile suggests the possibility of a surface casing placed to 12 ft and a second casing placed inside the surface casing to 40 ft. This is speculative but should be considered during decommissioning of the borehole.

Moisture data indicate some variability. However, caution should be exercised when interpreting the data because of the possibility of unknown borehole construction.

A comparison plot of the 1993 RLS (operated by Westinghouse Hanford Company and Waste Management Federal Services NW, respectively) spectral gamma data and 2006 SGLS data is included. There is

generally good agreement in the assays for ^{137}Cs, ^{233}Pa, and ^{239}Pu. It should be noted that the RLS analysis for ^{239}Pu used the 413.71 keV gamma ray and the SGLS analysis used the 129.3 keV gamma ray. Because of interfering gamma rays, the assay for the 413.71 gamma ray could slightly overestimate the ^{239}Pu concentration, and as discussed above, the assay using the 129.3 keV gamma ray could slightly underestimate the concentration.

The ^{241}Am concentrations determined in 1993 and 2006 do not agree well. The 1993 data were acquired with a less efficient detector (35% vs. 70%) and the counting time was 120 seconds versus 400 seconds. The discrepancies in concentrations for ^{241}Am are believed to result from the less efficient detector and insufficient counting times used for the 1993 RLS data.

The SGLS, NMLS, and PNLS repeat logs all show good repeatability.

List of Log Plots:

Depth Reference is top of casing
Depth Scale - 20 ft/inch except for repeat logs

Man-made Radionuclide Plot
Natural Gamma Logs
Combination Plot (20 ft/inch)
Combination Plot (10 ft/inch)
Total Gamma, Moisture, & Passive Neutron
Total Gamma & Dead Time
SGLS/RLS Man-made Comparison Plot
Manmade Radionuclides Repeat Plot
Repeat Section of Natural Gamma Logs
Repeat Data for Passive Neutron & Moisture

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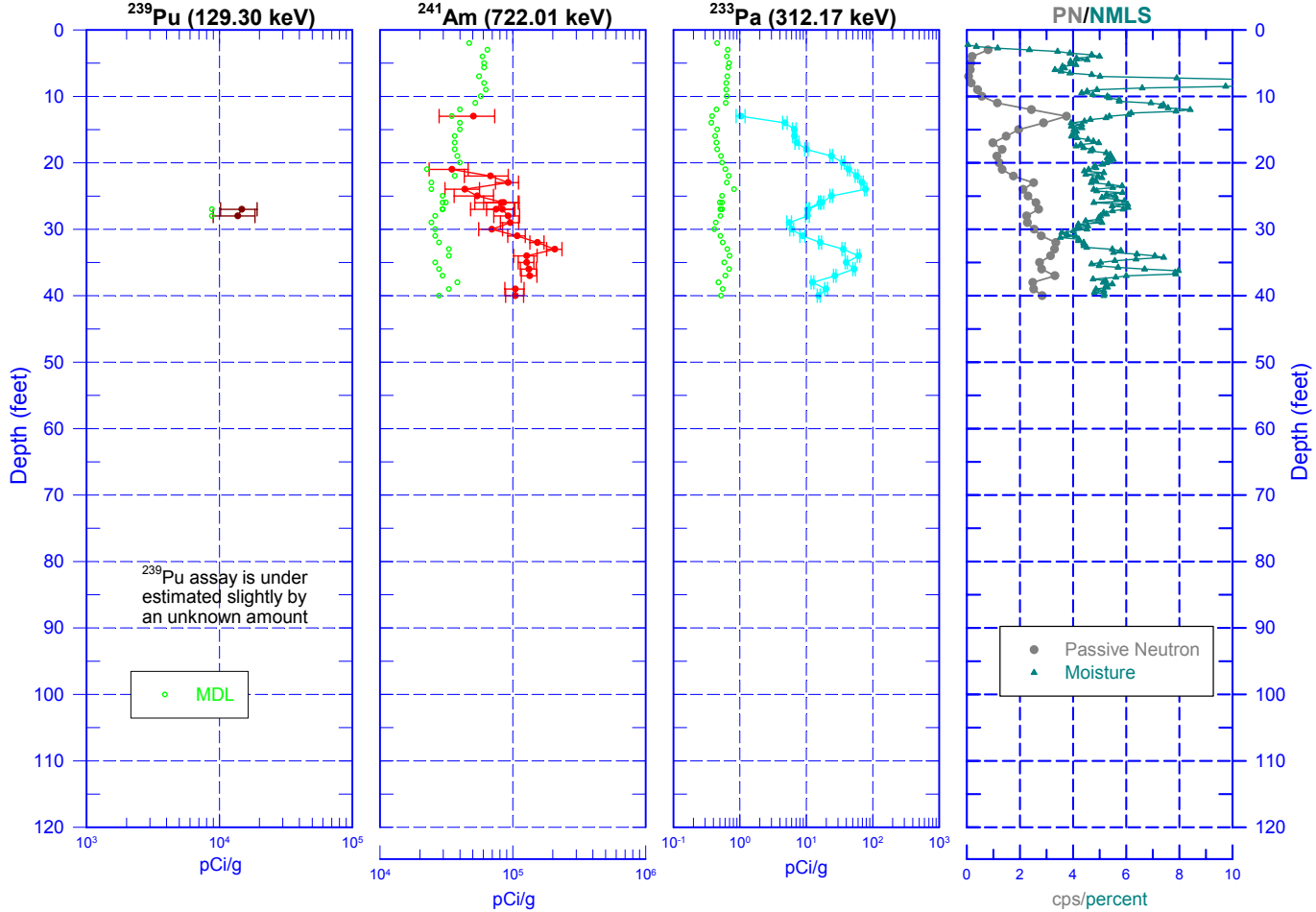
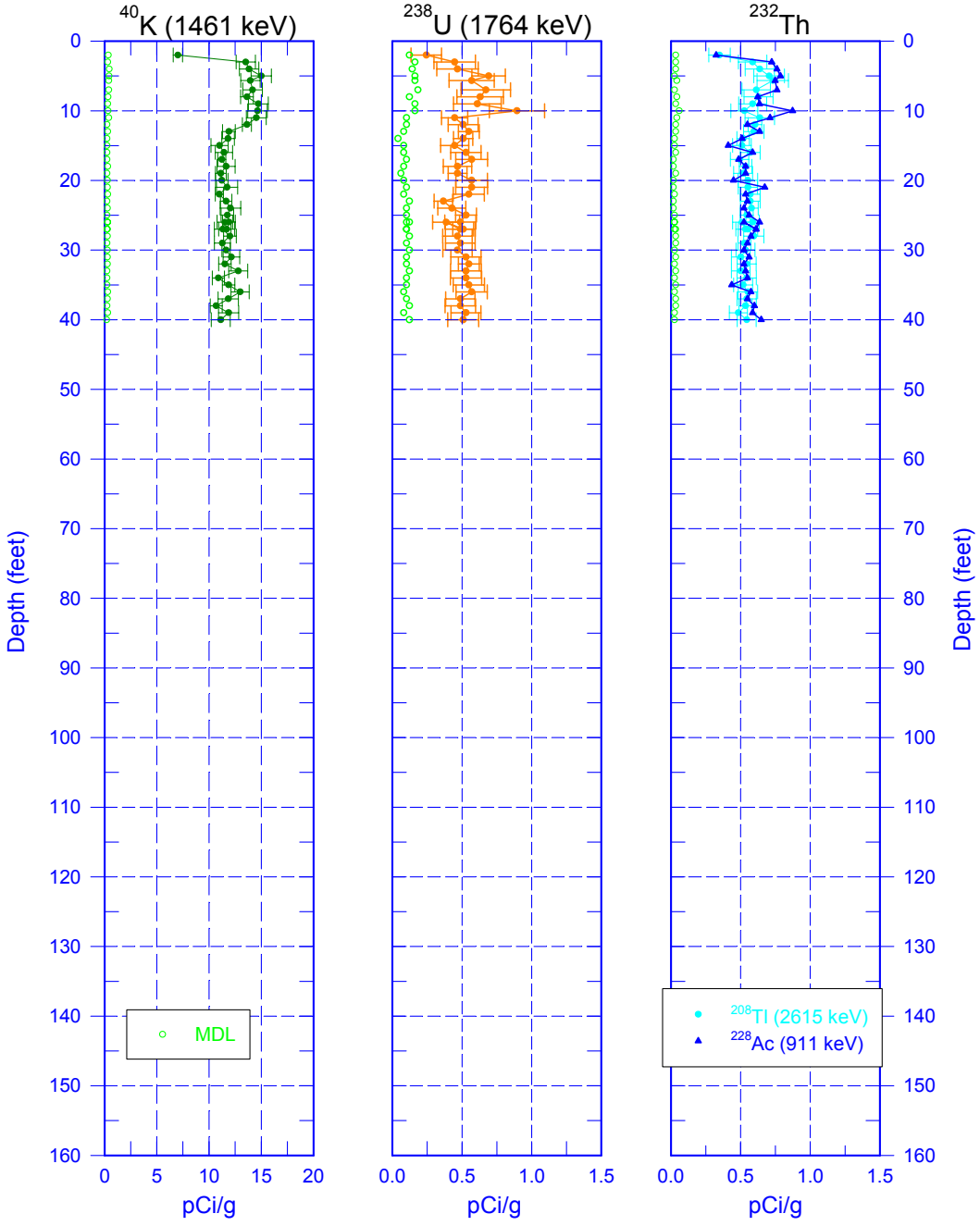
[1] GWL – groundwater level
[2] N/A – not applicable

299-W18-81 (A7564) Man-made Radionuclide Plot



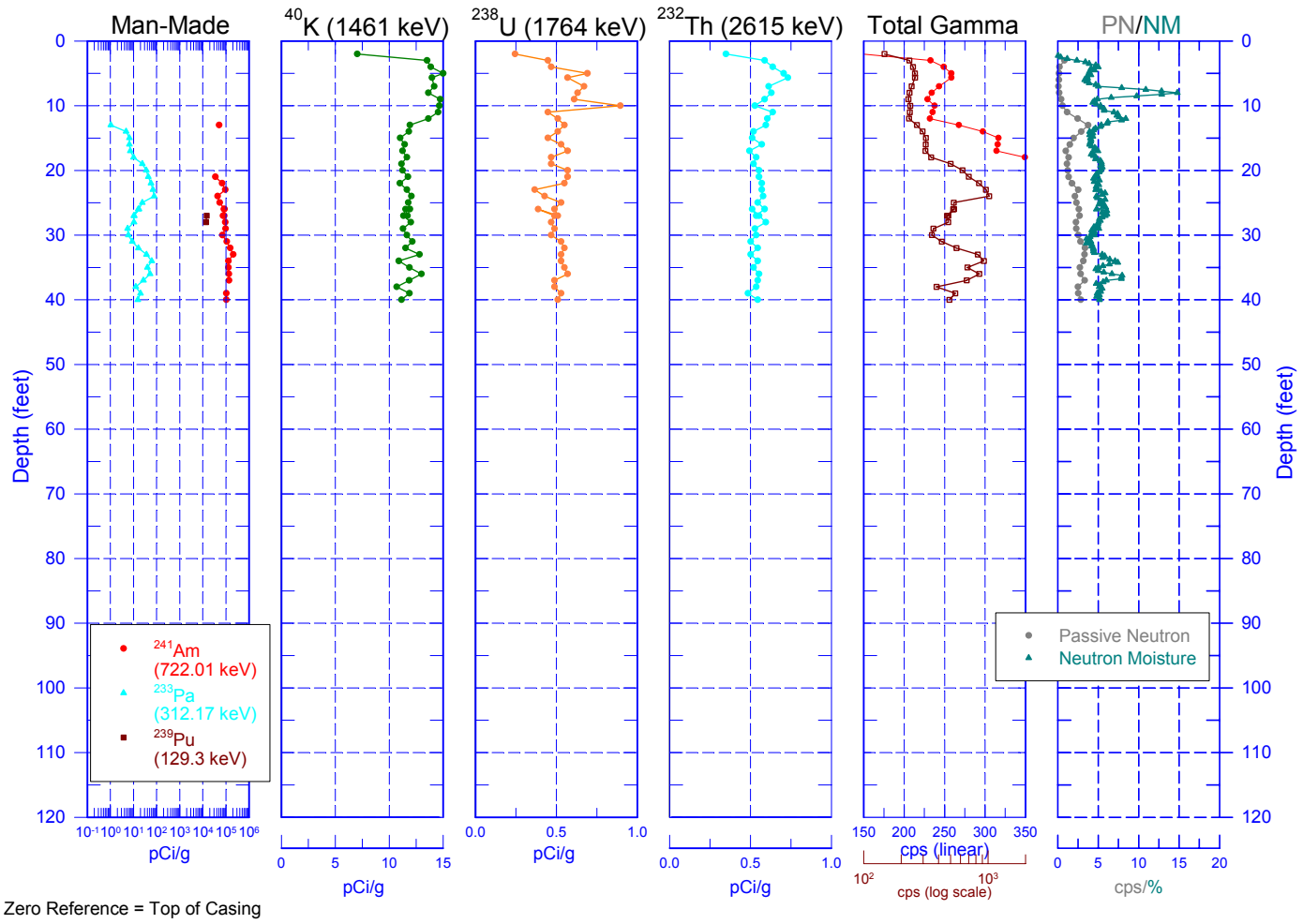
Zero Reference = Top of Casing

299-W18-81 (A7564)
Natural Gamma Logs



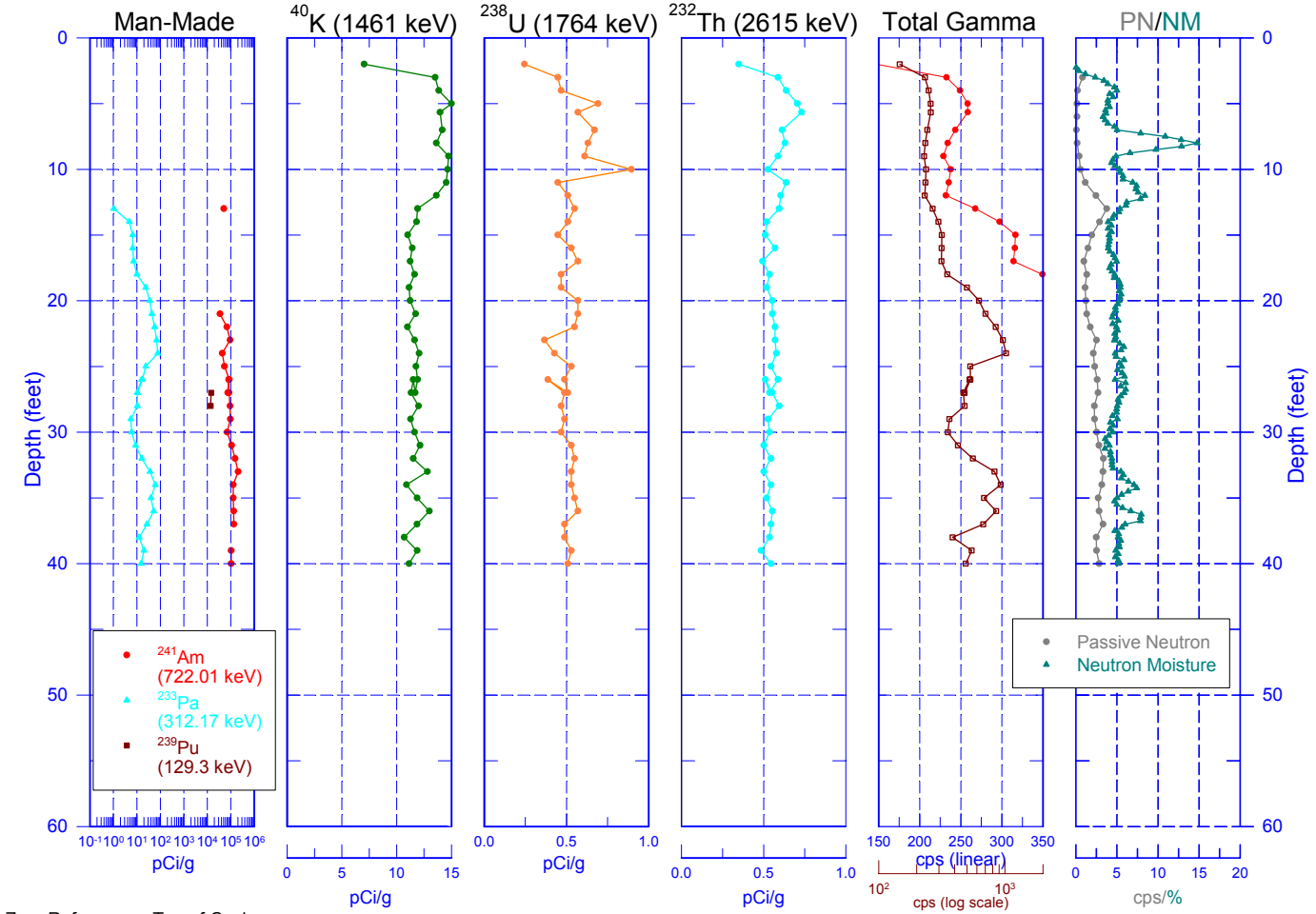
Zero Reference = Top of Casing

299-W18-81 (A7564) Combination Plot



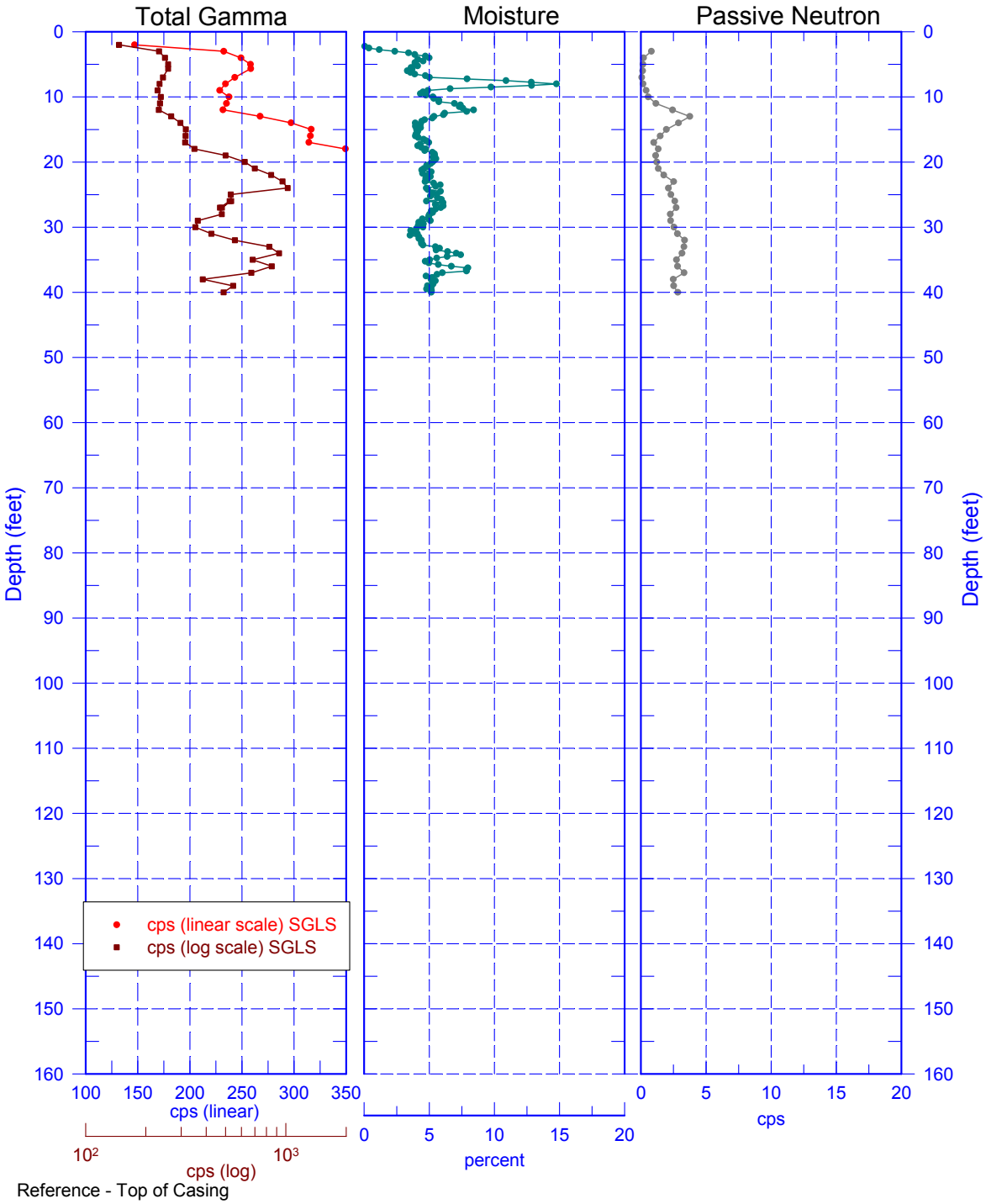
Zero Reference = Top of Casing

299-W18-81 (A7564) Combination Plot

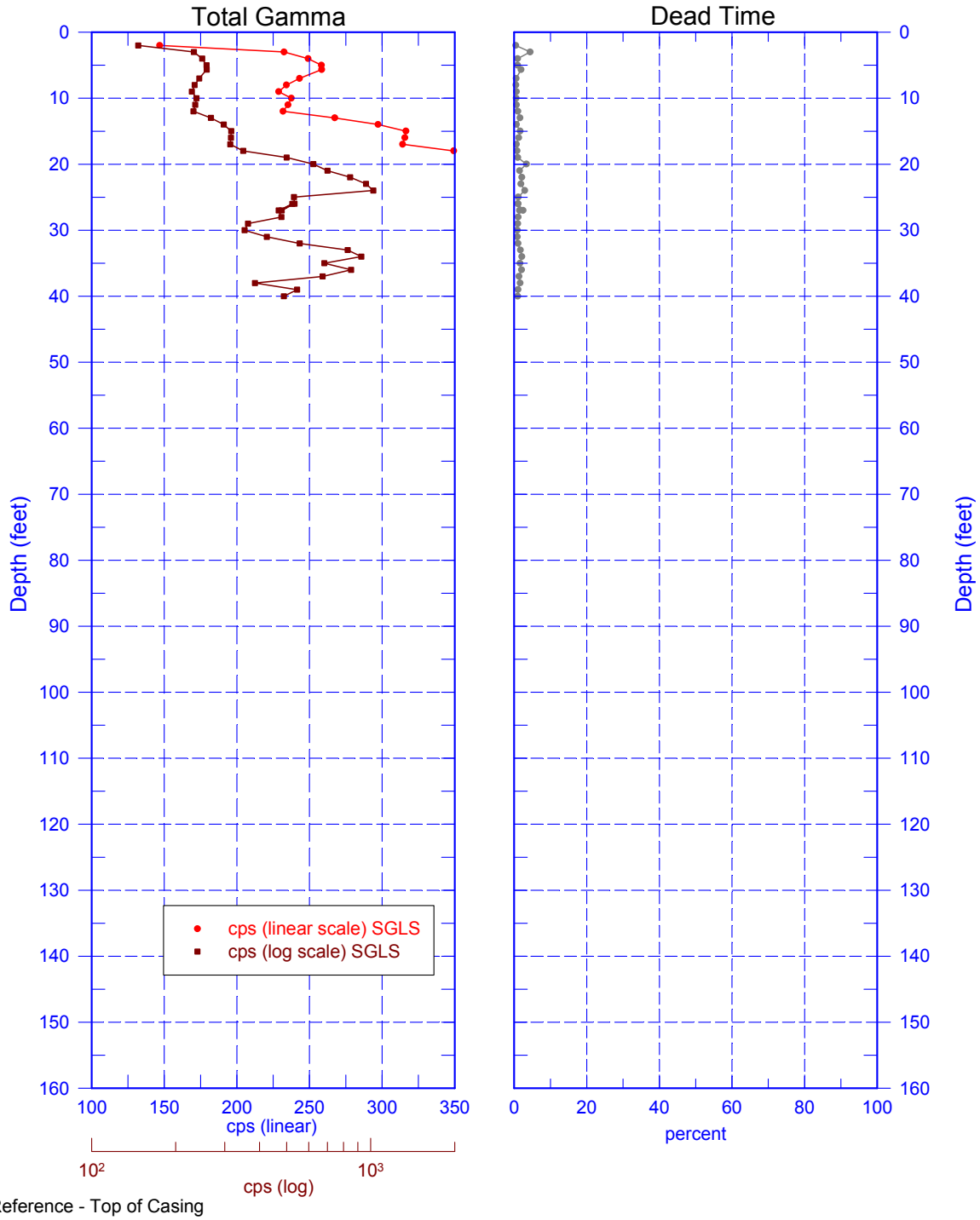


Zero Reference = Top of Casing

299-W18-81 (A7564)
Total Gamma, Moisture & Passive Neutron

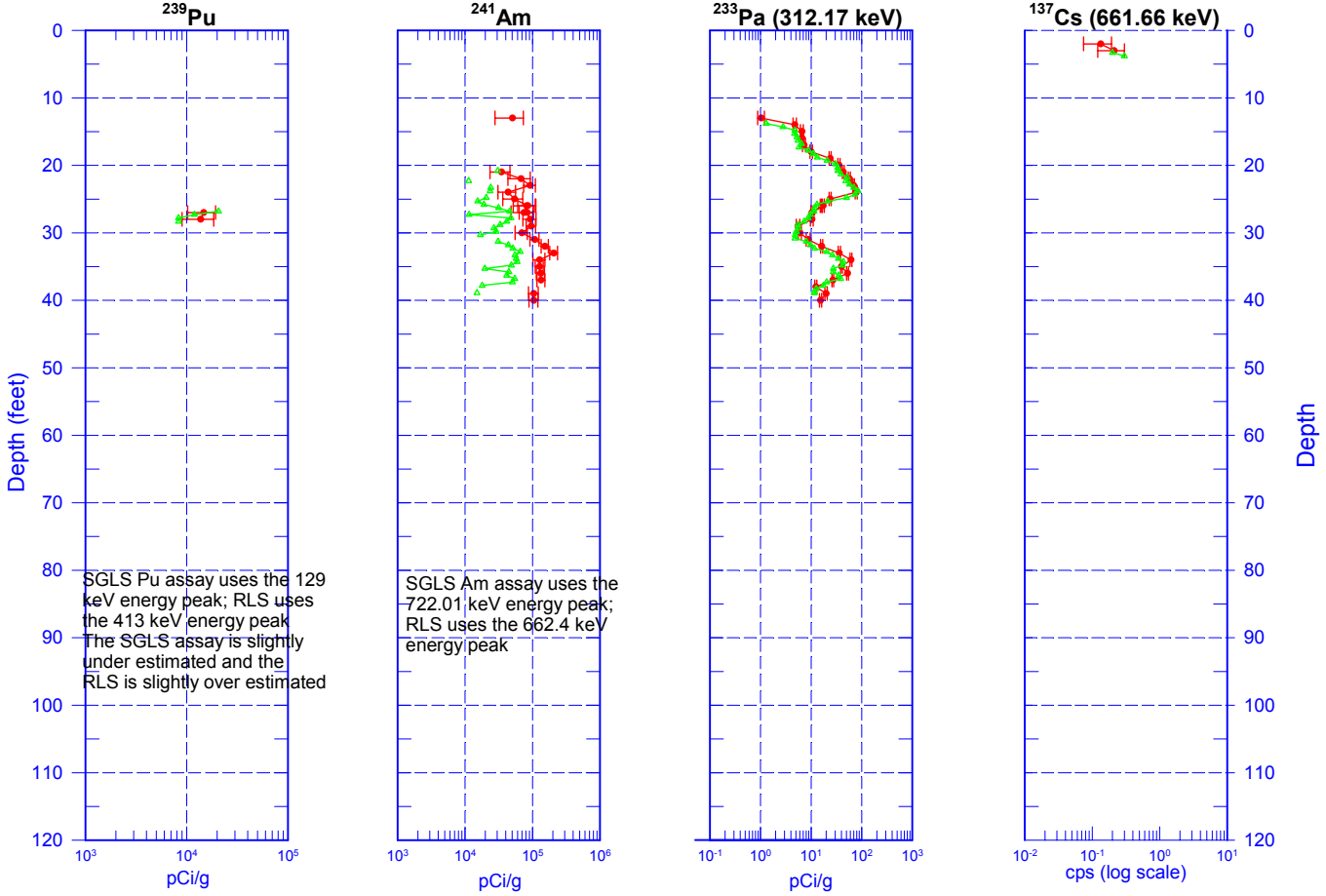


299-W18-81 (A7564)
Total Gamma & Dead Time



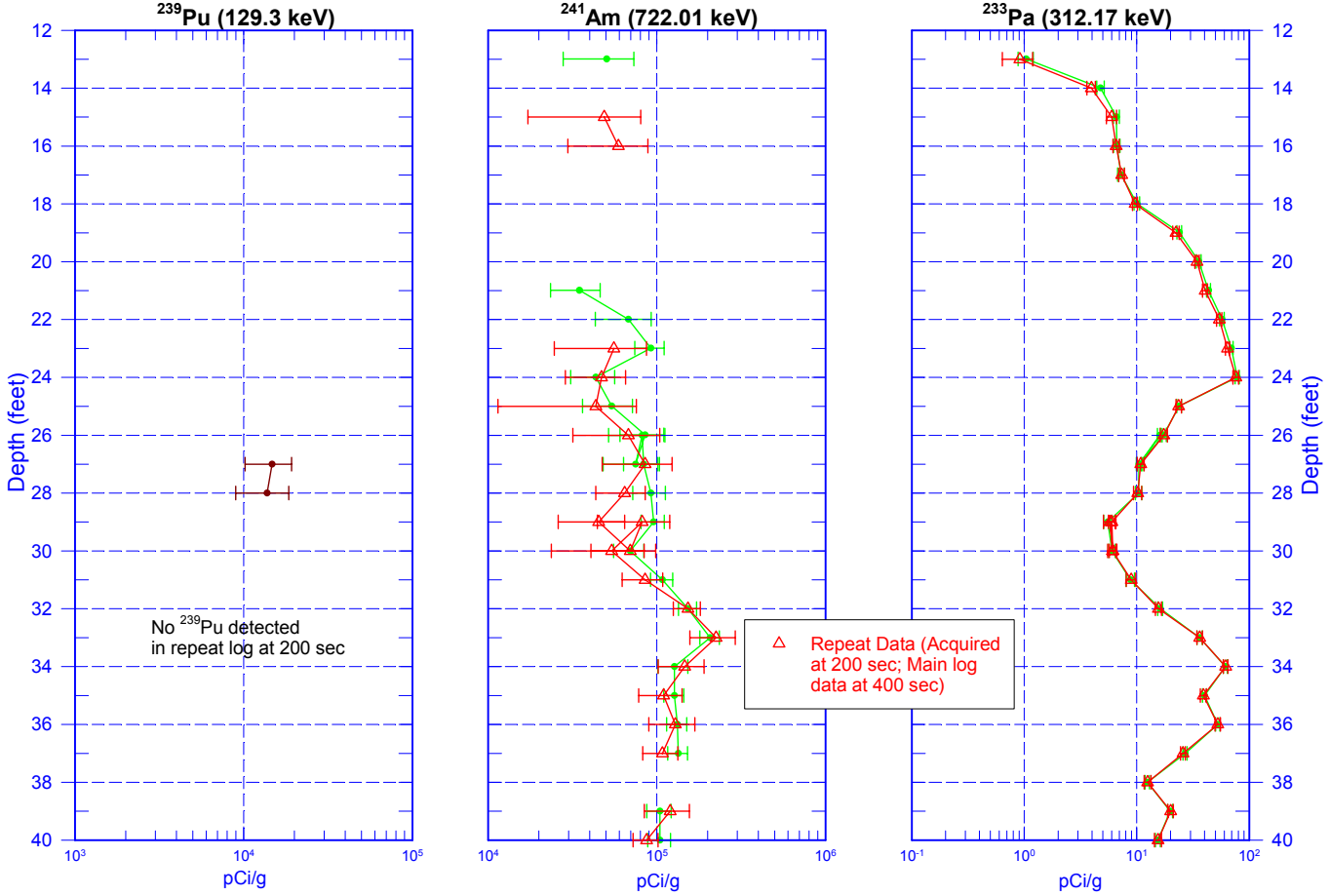
Reference - Top of Casing

299-W18-81 (A7564) SGLS/RLS Manmade Comparison Plot



Zero Reference = Top of Casing

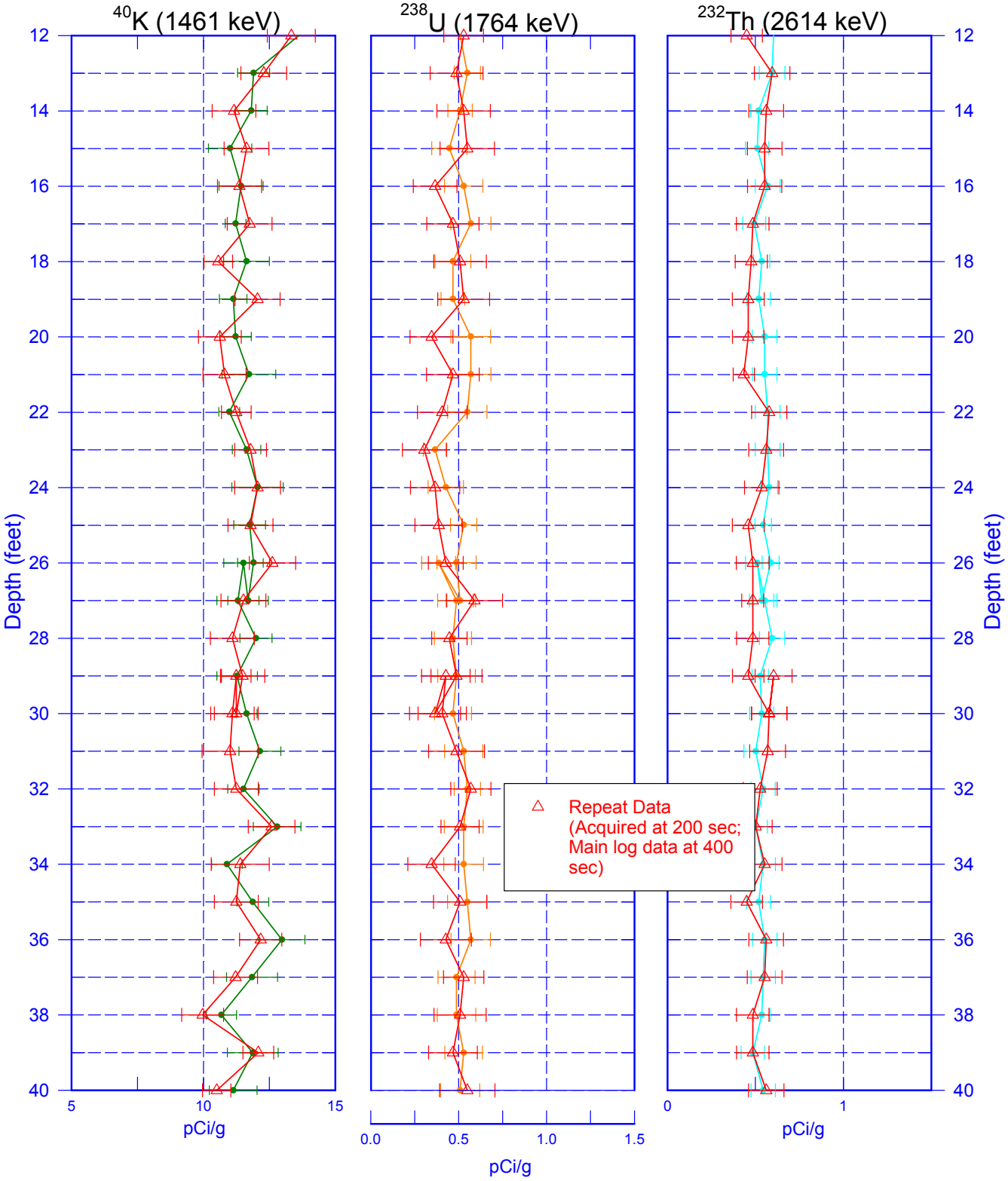
299-W18-81 (A7564) Manmade Radionuclides Repeat Plot



Zero Reference = Top of Casing

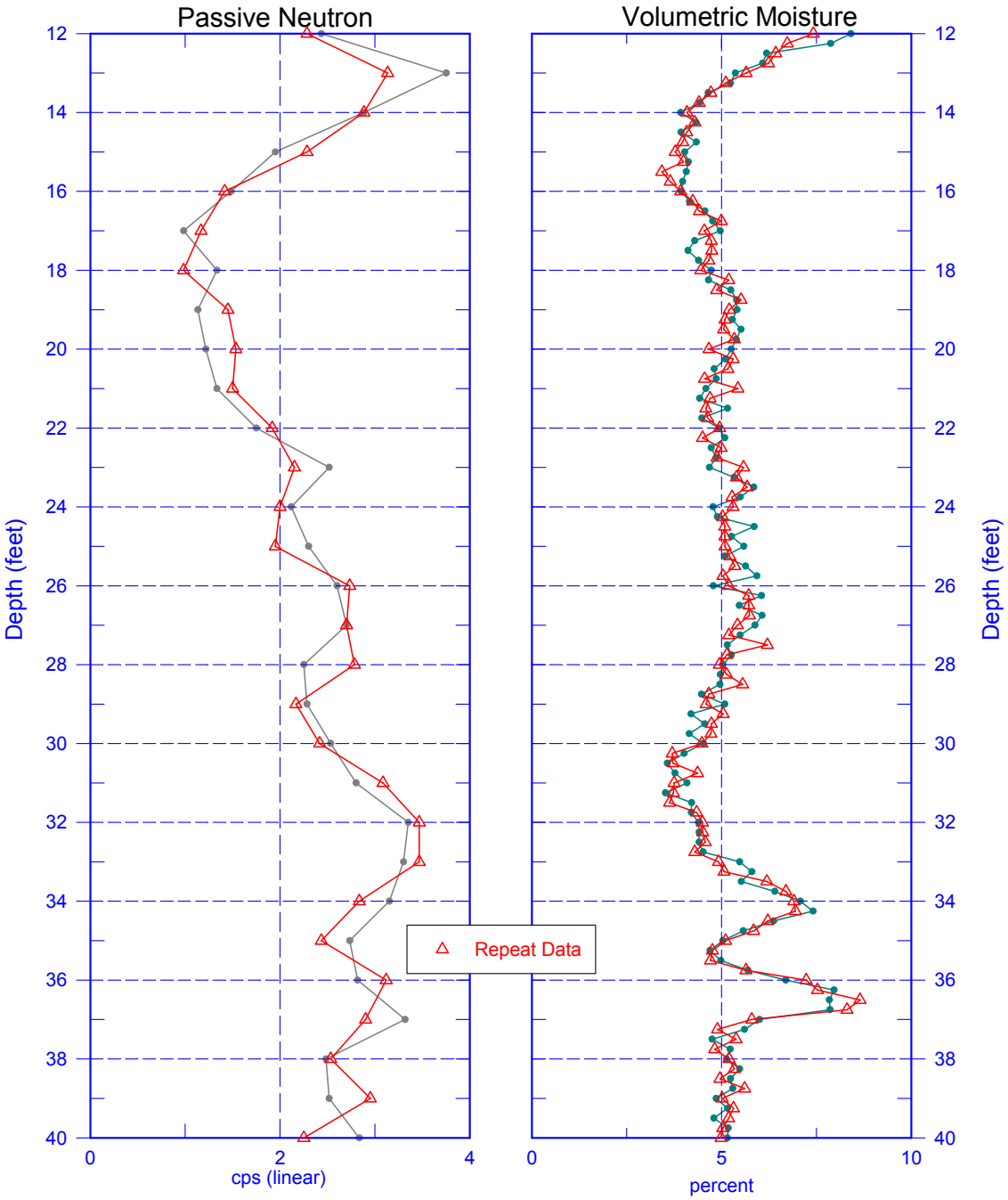
299-W18-81 (A7564)

Repeat Section of Natural Gamma Logs



Zero Reference = Top of Casing

299-W18-81 (A7564)
Repeat Data for Passive Neutron & Moisture



Reference - Top of Casing